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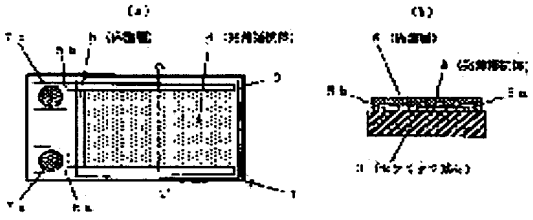
(54) CERAMIC HEATER AND HOT WATER DEVICE USING THE SAME

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a ceramic heater for heating hot water that is small-sized and thin and excellent in thermal shock resistance and heat exchange efficiency, and a hot water device using the same.

SOLUTION: The ceramic heater comprises a heat generating resistor 4 of a rectangular shape which is installed on the surface of a ceramic substrate 3, plural electrodes 5 which are connected with the opposing top ends of the heat generating resistor 4, plural terminals 7 which are respectively connected with the electrode 5, and a protection layer 6 which is laminated on the surface of the heat generating resistor 4.



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CLAIMS

[Claim(s)]
[Claim 1] The ceramic heater characterized by having the exoergic resistor of the shape of a rectangle arranged in the front face of a ceramic base material, two or more electrodes connected to the edge at which this exoergic resistor counters, two or more terminals connected to this electrode, respectively, and the protective layer which carried out the laminating to said exoergic resistor front face.
[Claim 2] The sheet resistance of said electrode is a ceramic heater according to claim 1 characterized by being lower than the sheet resistance of said exoergic resistor.
[Claim 3] Claim 1 characterized by carrying out two or more formation of said exoergic resistor, or the ceramic heater of two given in any 1 term.
[Claim 4] Claim 1 characterized by having connected said two or more exoergic resistors to the serial, and connecting with a serial with a conductor with sheet resistance lower than the sheet resistance of said exoergic resistor thru/or a ceramic heater given in 3 any 1 terms.
[Claim 5] Warm water equipment characterized by to make said ceramic base material into a plate configuration, to prepare for the base or side face of a hot water reservoir tank equipped with the spout connected to close Minakuchi connected to feed water passage, and blowdown passage, to heat the water by which flowed from close Minakuchi and hot water storing was carried out in said exoergic resistor in a ceramic heater claim 1 thru/or given in 4 any 1 terms, and to discharge from a spout.
[Claim 6] Warm water equipment characterized by making said ceramic base material into the shape of a cartridge, connecting an end to feed water passage, connecting the other end to blowdown passage in a ceramic heater claim 1 thru/or given in 4 any 1 terms, respectively, heating the water which flowed from feed water passage in said exoergic resistor, and discharging to blowdown passage.
[Claim 7] Claim 5 characterized by having arranged said electrode so that the current which flows to said exoergic resistor may flow perpendicularly to the suicide-by-drowning direction of water thru/or warm water equipment given in 6 any 1 term written.
[Claim 8] Claim 5 characterized by having the heat insulator which covers the front face of said ceramic base material through the opening for heat insulation thru/or warm water equipment given in 7 any 1 terms.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] Especially this invention relates to the warm water equipment using the ceramic heater for warm water heating and it which heat water to predetermined temperature.
[Description of the Prior Art]
[0002] In recent years, the flash heating type warm water equipment which sank the exoergic section 24 of the plate-like ceramic heater 21 shown in drawing 6 inside the hot water reservoir tank with comparatively little capacity (not shown) as a heater for warm water heating is used with a miniaturization and lightweight-izing of goods equipped with warm water equipment. This ceramic heater 21 forms a circuit pattern 23 in the ceramic base material 22a front face before sintering which uses an alumina as a principal component first using the ingredient which consists of an alloy of a tungsten and molybdenum. the exoergic section 24 which generates heat when resistance is made to increase and it energizes by making a circuit pattern 23 juxtaposition, and the non-generating heat section 25 which does not generate heat even if it reduces resistance and energizes it by making it broad -- since -- it is constituted. Subsequently, after carrying out the laminating of the ceramic base material 22b to exoergic section 24 front face and really sintering at a reducing atmosphere furnace, silver solder is used for the both ends of the circuit pattern 23 which hits the non-generating heat section 25, and the energization terminals 26a and 26b are fixed to them. And by connecting and energizing supply voltage between both energization terminal 26a and 26b, the exoergic section 23 can be heated, the water in contact with the front face of a ceramic heater 21 can be heated, and it can consider as warm water.
[0003]
[Problem(s) to be Solved by the Invention] However, in order to use warm water equipment as a compact further, the wiring consistency of the exoergic section is made high, W consistency is lowered, or thickness of a base material is made thin and the heat transfer rate from the exoergic section to water is gathered, and while making small the temperature gradient of the internal temperature of a ceramic heater, and the water to heat, it is necessary to prevent generating of sink local heating for a current to the circuit pattern of the exoergic section at homogeneity.
[0004] In the aforementioned ceramic heater 21, if a wiring consistency is made high, in case the laminating of the ceramic base materials 22a and 22b will be carried out and they will be sintered, the adhesion of ceramic base material 22a and 22b falls, and there is a possibility that a base material 22 may exfoliate and a circuit pattern 23 may be disconnected at the time of heater heating. And while a crack will go into a ceramic heater 21 with the flection 27 as the starting point and the exoergic resistor 24 will be disconnected if chilled water touches there since a current flows intensively inside the flections 27a, 27b, and 27c of a circuit pattern 23 and is locally heated when it arranges making a thin line-like circuit pattern move in a zigzag direction using an ingredient with low sheet resistance, there is a possibility that a ceramic heater 22 may fracture. Moreover, when forming a circuit pattern 23 by screen-stencil etc., since a limitation is to make [are not sintered but] a base material thin since the configuration is unstable and it is easy to produce variation in printing thickness, a base material 22 tends to cause [of local heating] generating.
[0005] This invention was made in order to solve the above-mentioned technical problem, is small or a thin shape and aims at offering the warm water equipment using the ceramic heater for warm water heating and it excellent in cold energy-proof impact nature and heat exchange effectiveness.
[0006]
[Means for Solving the Problem and its Function and Effect] In order to solve the above-mentioned technical problem, invention according to claim 1 is a ceramic heater characterized by having the exoergic resistor of the shape of a rectangle arranged in the front face of a ceramic base material, two or more electrodes connected to the edge at which this exoergic resistor counters, two or more terminals connected to this electrode, respectively, and the protective layer

which carried out the laminating to said exoergic resistor front face.
[0007] The following operation effectiveness is done so by this configuration.
(1) Since it is not necessary to put an exoergic resistor with a ceramic base material, it becomes possible to arrange an exoergic resistor in a ceramic base material substantially entire surface, and W consistency can be made low as much as possible, the temperature rise per unit area of an exoergic resistor can be controlled, and distortion by the thermal stress of a base material can be controlled.
(2) Even if it makes a base material thin, exoergic nonuniformity cannot be produced but homogeneity can be made to generate heat.
(3) Since a temperature gradient will arise in the part in which the exoergic resistor is arranged, and the other part if the thickness of a base material becomes thin when an exoergic resistor with low sheet resistance is arranged in the configuration where it moved in a zigzag direction, for example, homogeneity cannot be made to generate heat. Then, by forming an exoergic resistor in the shape of [without a flection] a rectangle (a square, rectangle, etc.), the roughness and fineness of a current do not arise locally and the open circuit by local abnormality heating can be prevented.
(4) It becomes possible to trim an exoergic resistor and to carry out resistance adjustment, and a controllability improves.
(5) Since a heat transfer rate can improve by thin shape-ization of a base material being attained, for example, setting the thickness to about 0.5-1mm, in order to print an exoergic resistor to the sintered ceramic base material and responsibility can be raised, water can be heated in an instant.
(6) Thermal resistance improves by forming a protective layer in glass material, the exoergic resistor and the inter-electrode short circuit by dew condensation are prevented, and overcurrent destruction of a heater actuation circuit etc. can be prevented.
[0008] Invention according to claim 2 is characterized by the sheet resistance of said electrode being lower than the sheet resistance of said exoergic resistor. Although a heater will be enlarged since it is necessary to make the configuration of an electrode larger than an exoergic resistor in order to prevent generation of heat of an electrode when the sheet resistance of an electrode and an exoergic resistor is the same, by making the sheet resistance of an electrode extremely smaller than the sheet resistance of an exoergic resistor, thinning of the electrode is carried out and miniaturization of the heater itself can be attained. Moreover, it can become possible to pass a current to homogeneity at the whole exoergic resistor, and a base material can be made to generate heat to homogeneity.
[0009] Invention according to claim 3 is characterized by carrying out two or more formation of said exoergic resistor. By this configuration, it becomes easy by arranging two or more exoergic resistors in the location of arbitration to obtain the calorific value of arbitration. Moreover, by arranging two or more exoergic resistors from which sheet resistance differs, since the miniaturization of an exoergic resistor can be attained rather than sheet resistance arranges two or more same exoergic resistors, the miniaturization of a heater can be attained. And further, in case [in which calorific value can be adjusted to arbitration also in the same area by forming an exoergic resistor with the construction material from which sheet resistance differs, respectively] an exoergic resistor is formed by screen-stencil, local heating can be prevented by suppressing the variation in thickness, and the variation in resistance can be controlled.
[0010] Invention according to claim 4 is characterized by connecting said exoergic resistor to a serial with a conductor with sheet resistance lower than the sheet resistance of said exoergic resistor. By making the sheet resistance of a conductor extremely lower than the sheet resistance of an exoergic resistor, a current cannot flow intensively to a flection and local heating can be prevented. By using an ingredient with low (there being few mixed ratios of a glass frit) sheet resistance for an exoergic resistor, the thermal resistance of an exoergic resistor improves and the heater of the high power with which two or more arrangement of the thin line-like heating element was carried out can be formed.

[0011] Invention according to claim 5 is warm water equipment characterized by making a ceramic base material into a plate configuration, preparing for the base or side face of a hot water reservoir tank equipped with the spout connected to close Minakuchi connected to feed water passage, and blowdown passage, heating the water by which hot water storing was flowed and carried out from close Minakuchi in said exoergic resistor, and discharging from a spout. Water can be efficiently heated in a direct ceramic heater by using the ceramic heater itself as some tank outer walls. Moreover, the water in a hot water reservoir tank can be heated without nonuniformity by sticking a ceramic heater on a hot water reservoir tank base.
[0012] Invention according to claim 6 is warm water equipment characterized by making a ceramic base material into the shape of a cartridge, connecting an end to feed water passage, as for it, connecting the other end to blowdown passage, respectively, heating the water which flowed from feed water passage in said exoergic resistor, and discharging to blowdown passage. Therefore, since a hot water reservoir tank is not needed, while being able to attain a

miniaturization, since responsibility improves, the mutual discharged water of warm water and chilled water can carry out with a sufficient precision. Especially, in the field of a health washing station, it is small, and although warm water equipment of the flash heating type excellent in responsibility is desired, miniaturization can be attained by having warm water equipment of this invention in recent years. Two or more passage can be formed in a ceramic heater inner surface, the passage cross section can be made small, or improvement means in the rate of flow, such as carrying out spiral passage formation using a resin metallurgy group ingredient, can be established, and the temperature rise of an outside surface and generating of an ebullition sound can be prevented by raising the heat transfer rate to water.
[0013] Invention according to claim 7 is characterized by having arranged said electrode so that the current which flows to said exoergic resistor may flow perpendicularly to the suicide-by-drowning direction of water. When making water flow into the interior of a cylindrical heater and generating warm water, a bias occurs in skin temperature distribution of an exoergic resistor with time near a close Minakuchi side and near a flood opening side. Since W consistency becomes large when improvement means in the rate of flow, such as a rod-like structure and a spiral, have been arranged inside a cylindrical ceramic base material in order for especially a problem such to raise a heat transfer rate and to aim at lowering of skin temperature, and reduction of an ebullition sound for example, it appears notably. Then, since the amount of currents which flows by arranging said two or more electrodes to the exoergic resistor by the side of close Minakuchi and a tapping hole can be adjusted, skin temperature distribution of a heater can be made into homogeneity so that the current which flows to said exoergic resistor may flow perpendicularly to the suicide-by-drowning direction of water.
[0014] Invention according to claim 8 is characterized by having the heat insulator which covers the front face of said ceramic base material through the opening for heat insulation. Since heat transfer of the heat accumulated in the heat insulator can be carried out to a heater base material, heat recovery can be planned and the skin temperature of a heat insulator can be reduced by contacting the part to a ceramic heater using the metal which was excellent in heat conduction, such as copper and aluminum, at the heat insulator in order to control the heat dissipation from a heater base material front face and to raise heat exchange effectiveness, it does not have an adverse effect on a heater peripheral device. And since it can prevent touching a heater base material front face directly, safety improves.
[0015]
[Embodiment of the Invention] A drawing explains the gestalt of operation of the ceramic heater which starts this invention below to a detail. In addition, in the drawing indicated to this example, the thickness of each part material differs from actual thickness. Drawing 1 is drawing showing the plate-like ceramic heater 1 concerning this invention, (a) is a top view and (b) is the A-A' sectional view of (a). This ceramic heater 1 on the front face of the sintered plate-like ceramic base material 3 The exoergic rectangle-like resistor 4, two or more terminals 7a and 7b which arrange so that two or more electrodes 5a and 5b may be connected to the edge (vertical edge of a graphic display) at which this exoergic resistor 4 counters, and are connected to these electrodes 5a and 5b, respectively, and the protective layer 6 which carried out the laminating to the front face of said exoergic resistor 4 -- since -- the outline configuration is carried out.
[0016] Although the thickness of the ceramic base material 3 changes with appearance configurations, when it considers that 2mm or more, a heat transfer rate, and lightweight-ization take productivity and workability into consideration, its less than 2mm is desirable.
[0017] The exoergic resistor 4 of the shape of a rectangle which uses ruthenium oxide as a principal component is arranged in the front face of said ceramic base material 3.
[0018] Here, although it is necessary to be [which was formed in the shape of a thin line] making it move in a zigzag direction etc. exoergic resistor 4 and there are problems, such as printing nature and local heating, when it is going to arrange the exoergic resistor 4 in ceramic base material 3 front face with about [100-500mohm] sheet resistance at a compact, these problems are solvable by making sheet resistance high. For example, although resistance is determined by the width of face of the resistor which is in contact with the electrode, and the die length of an inter-electrode resistor, when 20 ohms is used for sheet resistance, a heating element configuration is determined as follows. When power of a heating element is set to 1000W and an electrical potential difference is set to 100V, the resistance of a heating element is (Power W) = (electrical-potential-difference V) x (electrical-potential-difference V) / resistance (omega).
It is set to 10 ohms from a ** type. The number of trucks required to acquire the resistance of 10 ohms when sheet resistance uses the ingredient of 20ohms / ** is number of trucks = resistance (omega) / sheet resistance (omega/**). It becomes 0.5** from a ** type. When 0.4W /of power flux density is set to 2 mm in consideration of lifting of skin temperature, and generating of an ebullition sound, the truck area of the heating element of 1000W is truck area = (power W) / power flux density (W/mm2).

It is set to 2 from a ** type 2500mm. It determines as the number of trucks, the width of face of truck area to a heating element, and die length are the followings. The thickness at this time is around 10 micrometers.
Width-of-face =root (the number of truck area / trucks), several die-length = width-of-face x trucks : 70.7mm, die-length: -- the case where 200mohm is used for sheet resistance on the 35.4mm said conditions -- width-of-face:7.1mm and die-length: -- by doubling sheet resistance and doubling thickness 353.6mm again Even if a current flows locally by the variation in thickness but, the thing with the same resistance which an exoergic resistor disconnects can be prevented.
[0019] When an exoergic resistor is formed in the front face of a ceramic base material by screen-stencil etc., the variation in resistance may occur about **10%. As an approach of raising the resistance precision of an exoergic resistor, it is determined that the configuration of an exoergic resistor will become the resistance around 90% to the target resistance used as a specification. And when target resistance is not reached after exoergic resistor formation, the variation in resistance can be absorbed by cutting the side edge section of an exoergic resistor by laser in parallel with the direction of a current which flows to an exoergic resistor, and increasing and adjusting resistance.
[0020] The electrodes 5a and 5b of a thin line-like couple with which sheet resistance uses the silver not more than 20mohm as a principal component are arranged in the edge (vertical edge of a graphic display) at which the exoergic resistor 4 counters, and the energization terminals 7a and 7b of a couple later mentioned at the broad edge which is not in contact with the exoergic resistor 4 are formed, respectively.
[0021] Moreover, the laminating of the protective layer 6 of the exoergic resistor 4 which uses glass as a principal component is further carried out to the front face (the maximum front face). In case it calcinates by using glass ceramics as construction material of this protective layer 6, encroachment of the glass to the exoergic resistor 4 can be controlled, and the resistance variation of the exoergic resistor 4 can be suppressed. Or by using the glass material of the low melting point sintered around 500 degrees C, resistance fluctuation of the exoergic resistor 4 can be controlled and resistance variation can also be suppressed. Furthermore, by carrying out the laminating of the glass ceramics, or carrying out the laminating of the noncrystalline glass on the surface of glass ceramics, the pore in glass ceramics is buried and creeping discharge can be prevented. In addition, in the graphic display, although it indicated that the expedient top of explanation and a protective layer 6 hid in the exoergic resistor 4 and electrode 5 grade bottom, the whole abbreviation surface of exoergic resistor 4 grade is covered with the protective layer 6 in practice (refer to the sectional view of drawing 1 b).
[0022] The silver belonging to a periodic-table 1b group with which the energization terminals 7a and 7b of a couple do not form the nonconductor film in a nickel bar-chart side in the elevated-temperature atmospheric-air ambient atmosphere by 300-800 degrees C is plated. When specific resistance, such as silver, uses a small ingredient, generation of heat of a terminal can be prevented. Moreover, adhesion reinforcement and thermal resistance can be raised by joining Electrodes 5a and 5b and the energization terminals 7a and 7b by atmospheric-air baking at 700-800 degrees C using a silver ingredient. Moreover, by forming the part which touches the electrode 5 of the energization terminal 7 in the shape of a ctenidium, the surface area to which a silver ingredient adheres increases, and connection resilience improves. In addition, as construction material of the energization terminal 7, silver metallurgy, the alloy which consists of a 1b group element and platinum group metals can also be used.
[0023] The second example of this invention is shown in drawing 2 . In addition, about the same configuration member as the first above mentioned example, the same sign is attached and detail explanation is omitted. Other examples mentioned later are the same. The cylindrical ceramic heater 2 of this example arranges two or more exoergic resistors 4a, 4b, and 4c for two electrodes 5a and 5b to juxtaposition in preparation for the shaft orientations of the outside surface of the ceramic cylinder-like base material 3, and is carrying out the laminating of the protective layer 6 one by one. Like the first example, since the exoergic resistor 4 is arranged to the abbreviation perimeter (whole surface) of the ceramic base material 3, the whole can be heated to homogeneity.
[0024] The 3rd example is shown in drawing 3 . The plate-like ceramic heater 1 concerning this example While forming the exoergic resistors 4d, 4e, 4f, and 4g of plurality (a graphic display 4) formed in band-like in parallel with the front face of a base material 3 By arranging so that the edges of the exoergic resistor 4 which adjoins with the conductors 8a, 8b, and 8c of plurality (a graphic display 3) formed with construction material with sheet resistance smaller than two or more of these exoergic resistors 4 may be connected It has the description at the point of having connected the whole (4d-4g, 8a-8c) resistor to the serial. As an example, two or more exoergic resistors 4d-4g are formed with the sheet resistance ingredient of 200mohm, and two or more conductors 8a-8c are formed with the sheet resistance ingredient not more than 20mohm. Moreover, the electrodes 5a and 5b of a couple are also formed with the same construction material as a conductor 8. Thus, generation of heat near a flection can be reduced and a current can be made to pass and generate heat [homogeneity] to each exoergic resistors 4d-4g by constituting the flection of the series resistance object which

local heating tended to produce from conductors 8a-8c with low sheet resistance.
[0025] Next, a drawing explains the gestalt of operation of the warm water equipment concerning this invention to a detail. The plate ceramic heater 1 which showed the spout 10 connected to the blowdown passage which does not illustrate close Minakuchi 9 connected to the feed water passage which is not illustrated to the shell which the hot-water-storing heating type warm water equipment 19 shown in drawing 4 becomes from stainless steel material in the side-face lower part to the base of the hot water reservoir tank 11 established in the top face at drawing 1 is being fixed by the supporter material 12.
[0026] Since the exoergic resistor 4 is stuck to the hot water reservoir tank 11 through the ceramic base material 3, an insulation can be aimed at certainly, and improvement in thermal conductivity can be aimed at. In hot water reservoir tank 11 inner surface, warm water can be efficiently discharged from a spout 10 by establishing the turbulent flow acceleration means 13 so that the water which flowed from close Minakuchi 9 may be stirred.
[0027] It connected with the feed water passage which does not illustrate the end (graphic display left-hand side) of the cylindrical ceramic heater 2 shown in drawing 2 as close Minakuchi 9, and the flash heating type warm water equipment 20 shown in drawing 5 is connected to the blowdown passage which does not illustrate the other end (graphic display right-hand side) as a tapping hole 10. It is fixed so that the end of the heat insulation outer case 14 with a thickness of about 1mm it is thin from copper material may stick to the ceramic base material 3 directly near close Minakuchi 9, and the other end of the heat insulation outer case 14 is being fixed to the ceramic base material 3 section in which the exoergic resistor 4 is not arranged through O ring 15. The water which flowed from close Minakuchi 9 is gradually heated in the process in which it passes through the internal passage of the cylindrical metal heater 2, turns into warm water from a tapping hole 10, and is breathed out. Since heat transfer of the heat which radiated heat from cylindrical ceramic heater 2 outside surface is carried out to the ceramic base material 3 through the heat insulation outer case 14 at this time, while preventing the temperature rise of the heat insulation outer case 14, heat exchange effectiveness is raised. Moreover, heat exchange effectiveness improves further by connecting the end of a ****** outer case to direct close Minakuchi.
[0028] Here, the exoergic resistor 4 is arranged so that the current (the direction of [in / alpha / drawing]) which flows this exoergic resistor 4 may become perpendicular to the direction of passage of water (from graphic display right-hand side to left-hand side). By this configuration, it can prevent that a temperature gradient arises in a tapping hole 10 side the close Minakuchi 9 side of the cylindrical metal heater 2 as much as possible. Moreover, according to a heat transfer coefficient, the resistance of two or more exoergic resistors 4a, 4b, and 4c can be set up, respectively, and skin temperature distribution of the cylindrical metal heater 2 can be made into homogeneity.
[0029] According to a passage configuration, the cross section, etc. of the cylindrical ceramic heater 2 interior, cylindrical metal heater 2 the very thing is leaned, a congestion and growth of the air bubbles generated in the cylindrical metal heater 2 interior are prevented by arranging a tapping hole 10 in a location higher than close Minakuchi 9, and destruction of the cylindrical ceramic heater 2 by local heating can be prevented.
[0030] Although the example of this invention was explained above, as for this invention, it is needless to say that it can carry out in the mode which becomes various in the range which is not limited to an above-mentioned example or an above-mentioned operation gestalt at all, and does not deviate from the summary of this invention. For example, by arranging the shape of a rod and the improvement means in the rate of flow of spiral ** which are not illustrated, and raising a heat transfer rate, heat responsibility can be raised to the internal passage of the cylindrical metal heater 2, and the skin temperature of the cylindrical metal heater 2 can also be reduced to it. Moreover, although the plate may be curving, a cylinder may have irregularity in an inner surface and the energization terminal was collected at one end of a ceramic heater in this example, the same effectiveness can be acquired even if it arranges to ends. Furthermore, the warm water equipment of this invention is applicable to a health washing station, an electric water heater, an automatic washbasin with a warm water function, etc.
[0031]
[Effect of the Invention] As explained above, according to this invention, the warm water equipment using the ceramic heater for warm water heating and it cold energy-proof impact nature and heat exchange effectiveness excelled [it] in small or a thin shape can be offered.

[Translation done.]

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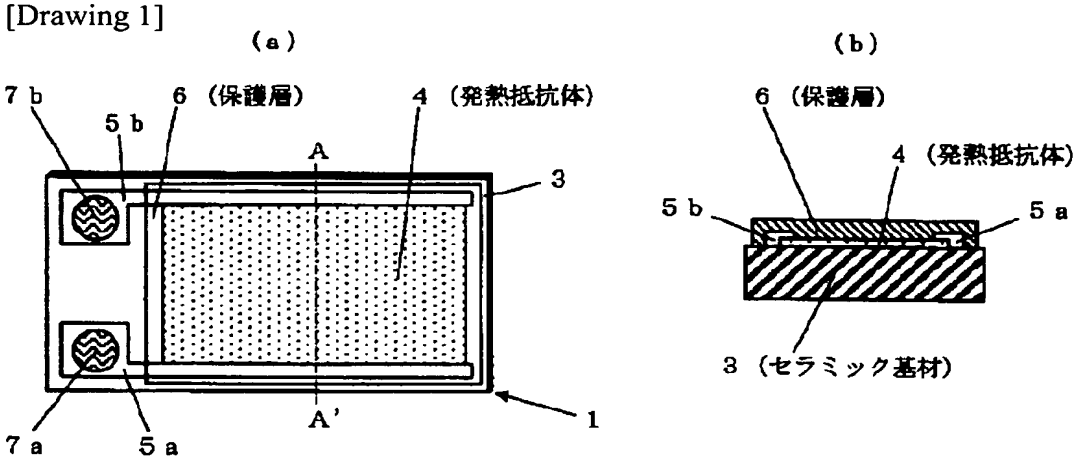
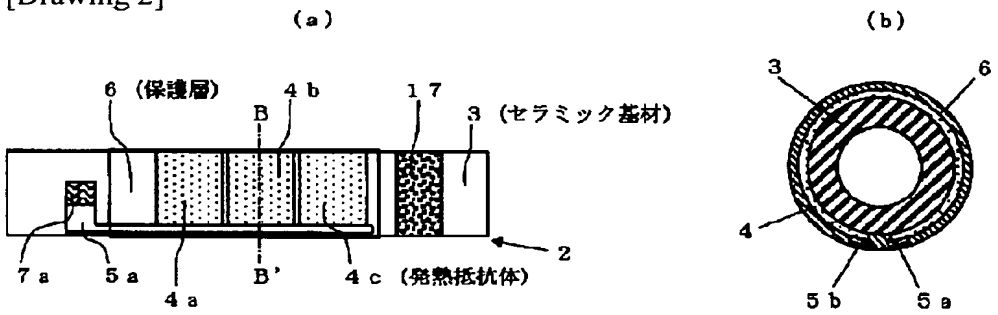
DRAWINGS

[Drawing 1]



[Drawing 2]



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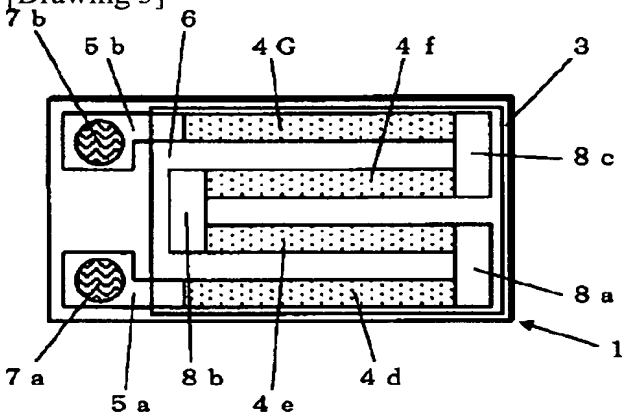

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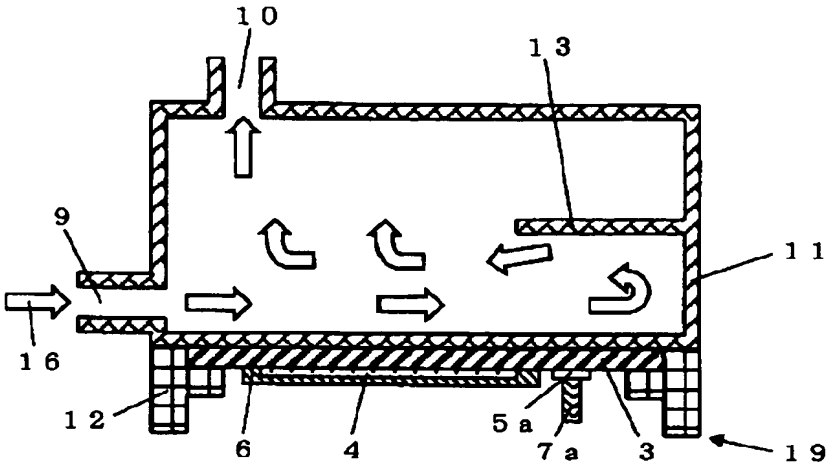

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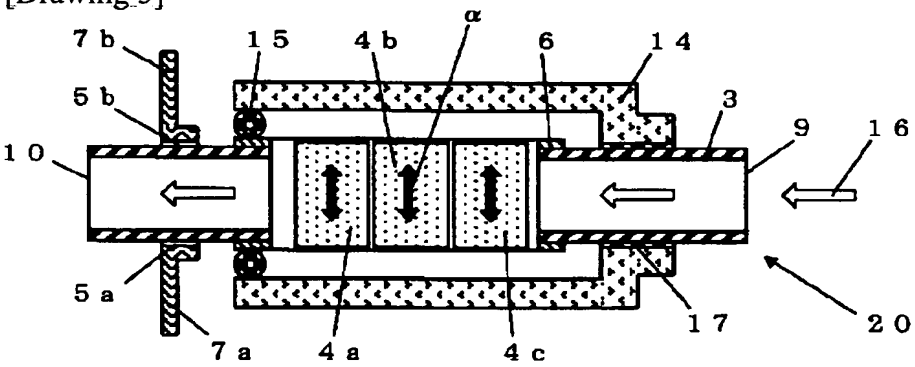
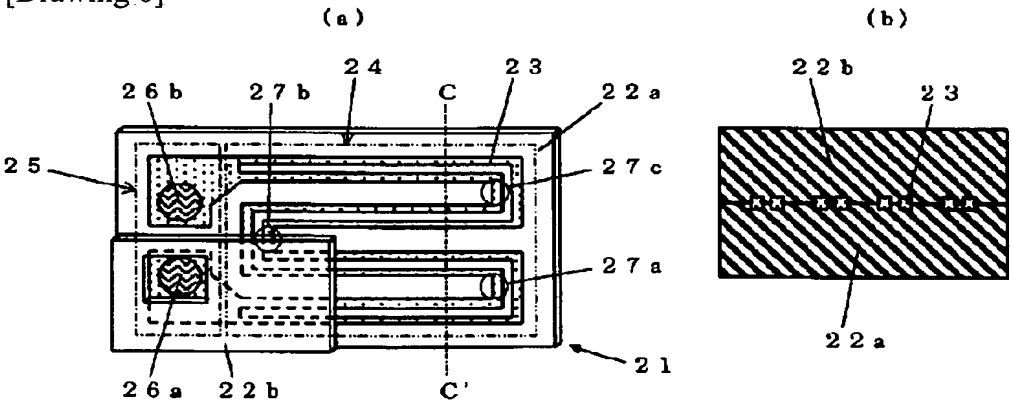


[Drawing 6]



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